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PATENT APPLICATION

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MODULAR FURNITURE FOR COMPUTER ASSISTED EXERCISE

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MODULAR FURNITURE FOR COMPUTER ASSISTED EXERCISE

This application claims priority under 35 U.S.C. § 120 from the provisional application 60/199,055 filed on April 22, 2000, by Andrew Nielson.

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BACKGROUND

Conventional exercise equipment enclosures lack facilities for use with computers for purposes other than control and monitoring of the exercise equipment or the exerciser. For example, a workout apparatus of the type described by Ghazi in U.S. patent 4,976,428 (issued Dec. 11, 1990) pivots for storage in a residence wall with no cooperation with computers; the wall having a door on a vertical hinge to hide the workout apparatus from view. Gym apparatus of the type described by Baswell in U.S. patent 4,431,181 (issued Feb. 14, 1984) pivots for storage in a cabinet housing; the face of the housing resting in an unprotected manner against the floor in front of the housing when the apparatus is in use. A treadmill of the type described by Watterson in U.S. patent 5,743,833 (issued Apr. 28, 1998) pivots into a housing in a manner similar to the Baswell design and provides feet extending from the surface that may protect the surface when the treadmill is in use. Watterson's apparatus provides only a machine control and display unit within the enclosure. An open exercise desk of the type described by Edelson in U.S. patent 5,257,701 (issued Nov. 2, 1993) does not

20 enclose exercise equipment but may be located over a treadmill or stationary bicycle; a work surface being provided to support a laptop computer for use by the exerciser. A stand-alone exercise desk of the type described by Densmore in U.S. patent 5,813,947 (issued Sep. 29, 1998) hides a treadmill or stepper behind two vertically hinged doors;

a top surface of the desk is provided for office equipment which may be connected to power and telephone outlets thereon.

Conventional exercise regimens may be accomplished using audio or video downloaded by data communication via the Internet, for example, as described by

5 Thomas in U.S. patent 6,027,428 (issued Feb. 22, 2000). As described by Shea in U.S. patent 6,042,519 (issued Mar. 28, 2000), multiple exercise stations may be coupled by a network to a station used by a system operator who has access to external data sources for display of news headlines, sports scores, stock market prices, weather reports, and advertising to exercisers while they exercise. In addition television may be provided to exercisers during exercising, for example, as also described by Shea.

In spite of the increased use of computer systems for business and for entertainment during exercise in the home and home-office, the need remains for furniture having, *inter alia*, structures, passages, and aesthetic features suitable for enclosing a system for computer assisted exercise.

SUMMARY OF THE INVENTION

15 A furniture system, according to various aspects of the present invention includes a module for enclosing exercise equipment, a module for enclosing computer equipment, a passage in each enclosure for power and/or signal cabling between the enclosures, and a support for a peripheral coupled to the computer equipment to
20 facilitate use of the peripheral by a user of the exercise equipment.

The furniture system may include vertical doors that when opened may be

stowed in a recess of the enclosure. By stowing the vertical door, the exterior surface of the door is protected from being marred during use of the computer equipment or exercise equipment. Particular aesthetic features of the furniture system are thereby maintained to be enjoyed when the equipment is not in use.

5 Each enclosure may provide openings at standard positions that may be selectively covered by trim so that passages may be aligned and terminal enclosures may provide a finished appearance, regardless of the sequence and arrangement of enclosures in a multiple enclosure arrangement. Any particular enclosure may then be easily used either as a terminal enclosure or an interdigitated enclosure when initially installed or differently when later repositioned.

By stowing each door within its enclosure, enclosures of many types may be arranged in linear, "T", and corner formations. By providing openings and covers individual enclosures may be used in a wide variety of formations.

15 Another furniture system, according to various aspects of the present invention includes two modules located back-to-back and a worksurface attached to both modules. Each module provides a passage for power and/or signal cabling between the enclosures and the worksurface. Exercise equipment may be located in either or both enclosures. Computer equipment may be located in either or both enclosures and/or on the worksurface.

20 An enclosure may include an interior wall that provides support for one or more shelves and defines a pocket for stowing a vertical door. By extending the interior wall

toward the back but not contacting the back of the enclosure, the interior wall will not interfere with vertical cable passage within the enclosure and will not interfere with access to a cable passage in the base.

An enclosure may provide horizontal rails for storing barbells. Further, such an enclosure may include a pivot for supporting an exercise bench. The bench suitably positioning an exerciser engaged in use of the barbells. Sound equipment, video equipment, exercise monitor equipment, and/or a graphical user interface may be provided in the enclosure for use by the exerciser. Such equipment may be coupled to other computer equipment by one or more direct or networked links. Storage of the barbells and bench are conveniently provided in one enclosure. When multiple displays are included in the enclosure, the exerciser may observe exercise performance information (e.g., personal repetition count or heart rate) as well as coaching, comparative performance, and entertainment information (e.g., video feeds from his own camera, others cameras, or from video programs obtained over the Internet).

An alternate enclosure may provide one or more shelves for supporting computer equipment. Further, such an enclosure may include a pivot for supporting a treadmill. The treadmill suitably positioning an exerciser engaged in use of the treadmill for use of sound equipment, video equipment, exercise monitor equipment, and/or a graphical user interface provided by the computer equipment in the enclosure. Such equipment may be coupled to other computer equipment by one or more direct or networked links. Storage of the computer equipment and treadmill can be conveniently

provided in one enclosure. When multiple displays are included in the enclosure, the exerciser may observe exercise performance information (e.g., personal repetition count or heart rate) as well as coaching, comparative performance, and entertainment information (e.g., video feeds from his own camera, others cameras, or from video programs obtained over the Internet).

A computer assisted exercise system, according to various aspects of the present invention, includes a workstation sphere, a workout sphere, and a link coupling the workstation sphere to the workout sphere. The workstation sphere includes a processor, a network interface for communication via the Internet, support for the link, and equipment for a graphical user interface. The workstation sphere may be used for conventional home/office computing tasks (e.g., document editing, Internet browsing, textual/audio/video teleconferencing, financial or business monitoring and planning, or multimedia composition). The workout sphere includes a processor, support for the link, exercise equipment, and a computer peripheral coupled to the workstation sphere by the link. By providing a computer peripheral integral to the workstation sphere for use by the exerciser (e.g., a graphical user interface or an audio and/or video monitor), exercise regimens as discussed above may be enjoyed or tasks ordinarily done in the workstation sphere may be initiated or continued from the workout sphere. Information related to the exerciser's performance (e.g., heart rate or video feed of exerciser's form) may be captured, stored, manipulated, and communicated in the same manner as conventional information associated with use of a conventional workstation or the

Internet.

BRIEF DESCRIPTION OF THE DRAWING

Embodiments of the present invention will now be further described with reference to the drawing in which:

5 FIG. 1 is a front view of a modular furniture system according to various aspects of the present invention;

FIG. 2 is a top view of the modular furniture system of Fig. 1;

FIG. 3 is a top view of a modular furniture system according to various aspects of the present invention;

FIG. 4 is a front view of a modular furniture system according to various aspects of the present invention;

FIG. 5 is a top view of the modular furniture system of Fig. 4;

FIG. 6 is a top view of a modular furniture system according to various aspects of the present invention;

15 FIG. 7 is a top view of the modular furniture system of Fig. 6 having exercise equipment deployed for use;

FIG. 8 is a perspective view of a portion of a furniture module of a modular furniture system of Figs. 1-7;

FIG. 9 is a front view of a furniture module of the modular furniture system of Figs 1-7;

FIG. 10 is a front view of another furniture module of the modular furniture

system of Figs. 1-7;

FIG. 11-12 are cross sectional views of the module of Fig. 9;

FIGS. 13-14 are perspective views of exercise equipment of the module of Fig.

10; and

FIG. 15 is a functional block diagram of a computer assisted exercise system according to various aspects of the present invention.

DETAILED DESCRIPTION

Embodiments of the present invention will now be further described with reference to the drawing, wherein like designations denote like elements. Conventional materials and construction techniques may be used in all enclosures and implementations discussed below.

Furniture system 102 of Figs. 1-2 is an implementation of modular furniture. There are three modules. Furniture system 102 includes enclosure 104, bookcase unit 106, and enclosure 108 arranged in a linear side-by-side fashion. Doors 112 and 113 of 104 and doors 122 and 123 of 108 are each supported on conventional a number of slide mounted hinges for opening away from the enclosure and for being stowed within the enclosure as in FIG. 2. Such slide mounted hinges are of the type used on big-screen TV cabinets. Doors may be split to permit access to upper portion 132 while leaving closed lower portion 130 and vice versa. Each module 104, 106, 108 includes a base 134, 135, 136 having a passage of the type discussed below with reference to 318, 328, 330, 814, 826, and 822 and as described in U.S. patent application

09/372,901 filed Aug. 12, 1999 by Nielsen, incorporated herein by reference. Modules may be free standing aligned in side-by-side arrangement; or, may be mechanically joined in any conventional manner to add rigidity to the implementation.

Enclosure 104 is shown in Fig. 2 open for deployment from 104 and use of bench 202. Bench 202 may be used with leg brace 204 for various exercises (e.g., sit-ups). Enclosure 108 is shown open for deployment from 108 and use of treadmill 212. Treadmill 212 includes moving surface 214 and handlebar 216.

Furniture system 302 of Fig. 3 is an implementation of modular furniture according to various aspects of the present invention. There are seven modules. Furniture system 302 includes enclosure 108, drawer file 304, wedge unit 306, enclosure 308, wedge 310, drawer file 312, and enclosure 104 arranged in an arcuate side-by-side fashion so as to fit in a 90 degree corner of a room. The base portion of each of enclosures 108, 308, and 104 are shown in cut-away view to reveal horizontal wiring passages and respective covers 314, 316, and 318. Each such cover has openings in each end 320, 322, 324, 326, 328, and 330 (selectively covered when not used) to facilitate vertical cable routing, such as entry/exit of cables between a wiring passage and the interior of one or more enclosures. Any of these modules may include one or more back openings through which power and/or signal cables may be routed between modules or, more preferably, to facility outlets. Enclosure 308 supports computer equipment for use as a workstation as discussed above and may be a computer armoire of the type described in U.S. patent application 09/264,469 filed

March 8, 1999 by Nielsen, incorporated herein by reference. Modules may be free standing aligned in side-by-side arrangement; or, may be mechanically joined in any conventional manner to add rigidity to the implementation.

Furniture system 402 of Figs. 4-5 is an implementation of modular furniture.

- 5 There are four modules. Furniture system 402 includes enclosure 104, enclosure 308 and enclosure 108 as discussed above. 402 further includes enclosure 404. All modules are arranged in a linear side-by-side fashion in a manner as described above with reference to FIG. 1. The systems of FIGs. 1 and 4 may use cable routing structures, passages, and features discussed with reference to FIG. 3. Enclosure 404 includes a pedestal table 410 comprising worksurface 406 and pedestal 408.

Worksurface 406 includes opening 502 for routing power and/or signal cables from the top of worksurface 406 to the interior of enclosure 404 where cables may enter a cable passage in base of 404 of the type described with reference to base 134 and items 318, 328, and 330. 502 may be covered when not used.

- 15 Furniture system 602 of Figs. 6-7 is an implementation of modular furniture. There are three modules. Furniture system 602 includes enclosure 104, enclosure 108, and pedestal table 410 as discussed above. Doors 112, 113, 122, and 123 (not shown) are closed so that exercise equipment and computer equipment may be hidden from view (except for equipment on worksurface 406). This "T" implementation provides a
- 20 "peninsula" arrangement suitable for locating side 604 or 606 perpendicular to a wall. Exercisers and workstation users may use 602 simultaneously from two sides 608 and

610 as described for desk 105 in the above referenced U.S. patent application 09/372,901. Exercise equipment may be deployed for use as shown in Fig. 7

FIG. 8 is a perspective view of enclosure 104 (door 113, exercise equipment, and computer equipment not shown for clarity of presentation of structural features).

5 Enclosure 104 includes base 134, top 804, sides 801 and 811, back 808, interior walls 803 and 813. Side 801 and interior wall 803 define pocket 802 for stowing door 113. Each door 112 and 113 may be supported by a conventional combination slide and hinge (not shown) as discussed above mounted on the top (facing top 804) and bottom (facing base 134) of the door.

10 Base 134, side 811, and side 801 have structures and passages facilitating cable routing as discussed above. Base 134 includes aperture 814 for cable passage covered by a trim cover (shown in place). Side 811 includes channel 826 having aperture 818 for cable passage shown without a trim cover so that 818 may be used for inter-enclosure routing. Side 801 includes channel 822 having aperture 824 aligned 15 identically to channel 826, aperture 818 to maximize the number of configurations for enclosure 104 as a module in a furniture system in accordance with various aspects of the present invention. These features may be of the type described in the above cited patent application 09/372,901.

20 Channels 826 and 822 include holes 820. These holes may be used to mount pedestal table 410, or mechanically join enclosures (e.g., aligned back-to-back, side-by-side in either of the two front-back facing configurations, to each other, or to facility

structure at an angle, for example, from 0 to 90 degrees).

Surface 805 include holes 806 in two columns for supporting in any conventional manner any number of shelves such as shelves 810 and 812. Shelves 810 and 812 may be used to support computer equipment or for storage of exercise equipment.

5 When rigidly mounted, a shelf may be used to mount safety structures, for example, handlebar 216. Shelves 810 and 812 may extend flush to back 808. Cable routing may be facilitated by holes (with covers for when hole not in use) in one or more shelves similar to hole 328. Identical horizontal alignment of 328 and such a hole may facilitate cable routing. Alternatively, one or more shelves may be spaced away from back 808 to provide cable routing at any convenient horizontal position.

Exercise equipment enclosed in enclosure 104 may include barbells 900 and bench 202 that pivots on bar 912 arranged as in Fig. 9. Computer equipment enclosed in enclosure 104 may include video camera 902, monitor 904, and laptop computer 906. Either 904 or 906 may provide a graphical user interface (e.g., touch screen, pen based, or mouse based). 906 may provide exercise performance monitoring. 904 may provide entertainment, coaching, or display a video feed provided by computer equipment in the workstation sphere. 906 may be portable and placed on shelf 810 during exercise, yet removed when the exerciser moves to another exercise station or when the exerciser is finished exercising. Communication between 906 and other computer equipment may be via any conventional link (e.g., dedicated or shared conductor(s), RF radio(s), infrared light(s), acoustic channel(s), or visible light(s)).

Likewise 904 may communicate with other computer equipment in any convenient manner as described above. One or more shelves in 104 (including shelves not shown) may be used for computer equipment that may be part of the workstation sphere or workout sphere.

5 Exercise equipment may be arranged in enclosure 108 as in Fig. 10, including treadmill 1010. Computer equipment arranged in enclosure 108 of Fig. 10 includes camera 1002, monitor 1004, and laptop computer 1008 (which may be identical in structure and function as described respectively above with reference to 902, 904, and 906). Treadmill 1010 includes moving surface 214, bed 1016 supporting the motion of a belt that provides moving surface 214, end support 1018 that supports 1016 off the floor so that bed 1016 is level in its lowest position yet still clears base front trim 1024, sides 1012 and 1013 on which handlebar 1020 is pivotally mounted, and supporting surface 1400 on which laptop computer 1008 rests. Cameras 902 and 1002 may be directed manually or under control of computer equipment to monitor use of computer
15 equipment and/or exercise equipment (e.g., exercise being accomplished with proper form -- position of exerciser's body and relative motions).

When either 104 or 108 is used in the above described "T" implementation, shelves (including shelves not shown) may be used to support other computer equipment. In this way an enclosure 104 or 108 may include all equipment of a
20 workstation sphere and workout sphere if desired.

FIG. 11 is a cross sectional view on a bisecting plane through enclosure 104 of

Fig. 9 with bench 202 stowed and doors closed. Bars 1102 mounted to interior walls 803, 813 support barbells 900. Leg brace 1102 may be stored separated from bench 202. Bench 202 has a center of gravity that keeps it in vertically stowed position for safety. A conventional latch may be added to 104 to secure bench 202 in stowed position. Shelf 810 may include a suitable front edge piece to limit abrasion, deformity, or marring of shelf 810 or bench 202. Hook and loop fasteners may be used on shelf 810 to retain bench 202 when shelf 812 is rigidly mounted within enclosure 104.

FIG. 12 is a cross sectional view on a bisecting plane through enclosure 104 of Fig. 9 with doors (not shown) opened and stowed in pockets and bench deployed. Bench 202 includes conventional mechanism 1206 for installing and removing bench 202 from pivot bar 912 (or otherwise connecting/disconnecting bench 202 from enclosure 104; legs 1208 that fold in any conventional manner for storage; and conventional mechanism 1204 for installing or removing leg brace 1102. Mechanisms 1206 and 1204 may utilize conventional pull pins for securing slidingly engaged tubular members in a reliable easy to manipulate manner.

FIG. 13 is a perspective view of treadmill 1010 in position for stowing in enclosure 108. Treadmill 1010, when installed in enclosure 108 rests on base 136 (and may be suitably rigidly attached thereto in any conventional manner) and fits snugly between interior walls (similar to walls 803 and 813 of 104). Treadmill 1010 includes base 1300, pivot 1304 on which handle 1020 is mounted to sides 1012 and 1013 (not shown), and pivot 1306 on which bed 1016 is moved into position for stowage or

deployed for use. End support 1018 is mounted to bed 1016 on pivot 1302. 1018 rotates 180 about degrees from deployed position to stowed position. 1018 is one integral piece made from steel channel (e.g., a weldment).

FIG. 14 is a perspective view of treadmill 1010 in position for use. 1018 provides support from the floor. 1400 supports laptop computer 1008. Rear wall 1404 provides displays 1402 and 1403 related to performance of exercise using treadmill 1010. Displays 1402 and 1403 may be controlled by a processor integrated into 1010 or may be driven from computer equipment described below.

FIG. 15 is a functional block diagram of a computer assisted exercise system according to various aspects of the present invention. System 1500 includes workstation sphere 1502 and workout sphere 1504. Workstation sphere 1502 includes computer equipment for tasks discussed above with reference to a workstation. Workstation sphere 1502 includes processor 1520 comprising graphical user interface 1528, disk 1530, net input/output interface 1534 (e.g., a TCP/IP stack), central processing unit 1524 (includes memory), and local network input/output interface 1532. 1528 connects in any conventional manner to monitor 1512 (preferably located in 308 but may be in 104, 108, on 406, or on 1400). 1528 also connects in any conventional manner to keyboard and mouse 1514; and to monitor 1518 (typical of any convenient number of monitors which may be identical in structure and function to monitor 1512 providing viewing outside the angle of view of monitor 1512). Disk 1530 stores programs and data used by CPU 1524 and communicates therewith on bus 1526. CPU

1524 communicates with all the above via bus 1526 for status monitoring and control.

For example, CPU 1524 may operate from disk 1530 an operating system of the type known as Microsoft Windows® operating system, a browser of the type known as an Internet Explorer® browser program, and any conventional video camera control

5 program for operations such as downloading and teleconferencing via the Internet, as discussed above. Camera control 1536 may control the direction of camera 1516 and may control multiple cameras as desired.

Workstation sphere 1502 communicates with workout sphere 1504 in any conventional manner such as for example Ethernet via any type of link as discussed above.

Workout sphere 1504 includes computer equipment for controlling and monitoring exercise. Workout sphere 1504 includes processor 1540 comprising graphical user interface 1548, disk 1550, central processing unit 1544 (includes memory), and local network input/output interface 1552. 1548 connects in any
15 conventional manner to display 1560 (e.g., an LCD display or a conventional monitor similar to 1512) (preferably located in 104 but may be in 308, 108, on 406, or on 1400).

1528 also connects in any conventional manner to keyboard and mouse 1562. Disk 1550 stores programs and data used by CPU 1544 and communicates therewith on bus 1546. CPU 1544 communicates with all the above via bus 1546 for status
20 monitoring and control. For example, CPU 1544 may operate from disk 1550 an operating system of the type known as Microsoft Windows® operating system and an

exercise equipment control program (e.g., a treadmill control program that directs the speed and elevation of bed 1016 to implement a conventional exercise regimen), a conventional exercise monitor program (e.g., a treadmill status display program that provides information as to the duration so far and to go of the exercise, the difficulty currently, past, and to go), and a conventional exerciser monitor program (e.g., heart rate, blood pressure, perspiration detector, body temperature monitor), as discussed above.

Spheres 1504 and 1502 communicate to permit exerciser 1592 to have some control over computing tasks accomplished by either or both spheres. For example, 1592 may via 1562 change camera direction for 1516; may select another program to be run on 1520 or 1540 to provide a different display on 1518, or 1560. Selection may result in a change to operation of 1562 to be consistent with the selected program. 1562 may be used as a proxy for 1514 as desired. Exerciser monitoring by processor 1540 may result in data communicated to 1520 and stored on disk 1530 or communicated via 1534. Results of exerciser monitoring or further signal processing accomplished by any one or more of 1540, 1520, or computers connected via 1534 may be displayed on 1512 (out of view of exerciser 1592), 1518 (in view of 1592) or preferably on display 1560 to be viewed by 1592 in parallel with information displayed on 1518. Displays such as 1402 and 1403 may be integral to 1590.

CPU 1544 may also perform programs from disk 1550 to control and monitor exercise equipment 1590 via interface 1558 and bus 1546. Files on disk 1550 may

transferred to 1550 via 1501 from disk 1530 or from 1534. Disk 1550 may be omitted when CPU 1544 has sufficient memory and suitable access to disk 1530 or 1534.

Workout sphere 1504 may in addition include displays, controls, monitors, and interfaces for performing any or all of the functions of the workstation sphere as discussed above. In such a comprehensive implementation, workout sphere may be redundant to workstation sphere for security purposes, parallel computing, or other conventional purposes (e.g., client-server applications or firewall). Workstation sphere 1502 may be omitted and its special purpose peripherals controlled by processor 1540.

Furniture systems, when modular, provide a few modules that may be used with any number of other similar or compatible modules in a wide variety of configurations. For example, a furniture system may include a bookshelf, a computer armoire, a special purpose exercise equipment enclosure, a general purpose exercise equipment enclosure, a drawer file, a pedestal table. These modules may themselves be formed from sub-modules which may be used as modules in so-called half-height applications.

For example, an armoire may consist of a computer enclosure base unit and accept one of a bookshelf upper unit or a special purpose upper unit. This way the base unit may be used when the upper unit is not desired. A bookshelf unit may consist of a bookshelf base unit and a bookshelf upper unit. The bookshelf base unit may be used to support a pedestal.

A modular furniture system according to various aspects of the present invention includes provision for computer equipment to be used with exercise equipment. Such

provisions include use of a common facility power and communication connection, distribution of power to computer and exercise equipment, distribution of signal cables (or location for proper operation of conventional wireless links) between computer and exercise equipment (e.g., within or between spheres), and physical support of

5 equipment in positions for use (conveniently usable) and for stowing for storage.

Use of the modular furniture systems discussed above include various methods of installation and exercise discussed below and which may be apparent to a person of ordinary skill from the structures discussed above. For example, in addition to the steps of installing modular furniture discussed in the cited application 09/372,901, installation may include placing exercise equipment (e.g., a treadmill, folding stationary bicycle, or universal gym) onto the base of an enclosure, affixing the exercise equipment to the base, routing power and signal cables, and installing doors on the enclosure. Because the enclosure may be shipped and placed in position without exercise equipment and doors the enclosure is lighter, less subject to damage, and more accurately handled.

15 Cable routing may be suitably accomplished before, during, or after equipment installation and door installation.

In a method of exercising according to various aspects of the present invention, an exerciser establishes an Internet connection, obtains information for controlling the exercise equipment, obtains information for monitoring the personal effects of exercise,

20 obtains information for entertainment, coaching, teleconferencing, and performs exercise in accordance with obtained information. Obtaining information may be by

one-time download or by conventional continuous streaming technology. Information may be obtained from a disk local to the exercise equipment, from a disk local to the computing equipment, or via access through a communication network (e.g., an intranet, the Internet, or the World Wide Web portion of the Internet).

5 Further, the above method may also include the steps of providing information from the exerciser (e.g., a heart rate monitor or camera viewing angle) for storage, analysis, teleconference, or display. The teleconference may be a one-time transfer or a continuous streaming connection as discussed above. Analysis and display may include a step performed by the exerciser of comparing personal information (e.g., form as monitored by video camera) to stored information or information obtained as discussed above.

Still further, the above method may also include selecting, revising, and further providing information, for example, as by enabling or redirecting a video camera or placing or replacing a physical monitor (e.g., a cardiovascular sensor)

15 Modular furniture systems are more easily marketed than integral and stand-alone furniture. Manufacturing, warehousing, transportation, sales, and repair may be streamlined by reducing the number of modules yet satisfying a wide variety of customer expectations.

The foregoing description discusses preferred embodiments of the present
20 invention which may be changed or modified without departing from the scope of the present invention as defined in the claims. While for the sake of clarity of description,

several specific embodiments of the invention have been described, the scope of the invention is intended to be measured by the claims as set forth below.

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